DMA-1005
SECTION

PROGRAMMED TEST SOURCES, inc.

Littleton, Massachusetts, USA.

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INTRODUCTION

The DMA-1005, digit module-A, is used once per instrument and generates the 1 MHz steps. It is very similar to the DM-1000 module and is fed by the string of all DMs in the instrument. As the last unit of this series, it's output at 140-150 MHz contains the 1 MHz steps and all finer steps for which the instrument is equipped, down to 0.1 Hz.

This manual should be seen as supplemental and must be used in conjunction with the DM-1000 portion.

This digit module is of plug-in design and uses three 10-pin connectors with asymmetric spacing assuring proper orientation; it is secured with three 6-32 screws from the bottom of the deck. Housed in a frame and U-cover enclosure, the DMA-1005 can be removed as a complete unit after releasing the 6-32 pan-head screws. To gain access to the PC board, 4-40 top screws and all 2-56 side screws must be removed from the module U-cover. The PC board cannot be removed without first removing the module from the deck.

PRINCIPLES OF OPERATION

The main difference between the DM and DMA modules is the absence of the final division-by-ten in the DMA. As a result, the arithmetic function of the DMA-1005 can be described as follows:

When receiving a frequency of 14.xyz from the preceding DM, it will produce an output frequency of 14A.xyz MHz, where A directly corresponds to the DMA dial setting. In other words, all digits behind the decimal point are retained, and a 1 MHz step, as selected by the digit control (manual or remote), is placed ahead of the received digits.

All other observations made in the DM *Principles of Operation* apply here as well, and the frequencies shown in the block diagram (Figure 1) at the output of the DMA, namely 146.543210, would be obtained if the DMA had been instructed to produce a "6" digit.

Figure 2 shows the schematic of the DMA-1005, and, apart from the absence of the final divider, it may be noted that there are additional components used in the execution of the 14 to 22 MHz selection switch. This added, switched selectivity removes unwanted frequencies before they can enter the balanced mixer. These frequencies are not attenuated by division or a narrow-band output as they are in the DM-1000 module. All input levels to the DMA are identical with the levels for the DM modules. The output level of the DMA, however, at 140-150 MHz is +2 to +6 dBm into a 50 ohm load. The module feeds a mixer in the IM-1007 module through a 50 ohm pad.

SERVICE

Maintenance

No preventive maintenance is required for DMA modules. The presence of an output signal of correct frequency and level indicates that the module is operating properly. The output of the module is included in the leveling loop, and minor aging effects will, therefore, not impair operation.

Replacement of faulty components requires careful use of printed-circuit repair techniques as applicable to double-sided boards with plated-through holes.

Alignment

Complete alignment of this module is made at the factory with a special test-set. Restoring the alignment after replacement of individual parts in the field is possible. It is recommended that voltages given in the Troubleshooting Procedure be used and that, in general, touch-up alignment be performed only on those tuned circuits which may have been altered by the parts replacements. Replacement of semiconductors will not necessitate realignment of tuned circuits in general.

Troubleshooting Procedure

The System Section of this manual provides information to isolate faulty modules. It is important to follow the procedure given in detail to ensure that all the common supply frequencies are present before attempting to repair modules.

If a DMA module has been isolated as faulty, the preferred service mode is exchange and factory repair. When immediate service is needed, the following procedure may be used.

Test Equipment Required:

RF Voltmeter	1 - 300 MHz, 10 mV - 1V, High Impedance Probe (3 pF, DC Res 100 KΩ)
HF Counter	0 - 200 MHz, 10 mV Sensitivity, High Impedance or 50 Ω Input

The output of the DMA module is on pin 50, which is also the test point designation used in the System Section and the running number of the board-edge connector as shown in the schematic (Figure 2). The module produces 140.000 MHz at a level of +2 to +6 dBm into the IM module if all instrument dials have been set to zero. As the dial of the DMA module is changed through successive numbers 0 to 9, the output frequency should change in 1 MHz steps from 140.000 MHz to 149.000 MHz. If the output is of the proper frequency but low in level, the fault is in the 14-22 MHz switch, the mixer (M1), or the 140-150 MHz output filters L6 to L10 and transistor Q11. Alignment of this section cannot be restored in the field, but active devices are generally replaceable without need for realignment. See DC operating conditions listed below.

Absence of output for some dial settings points to specific causes:

1. No output on *two* successive even-odd digits (e.g., 2,3) indicates that the second mixer, M1, does not receive one of the low bus frequencies from 14 to 22 MHz, and the fault is likely located in the switch section (Q3 to Q7). 14 MHz is used for digit 0,1; 16 MHz for digit 2,3; and so on.

2. No output on either *all odd* or *all even* digits will result from failure in the 112/113 MHz switches Q1 or Q2, since 112 MHz is used to produce all even digits and 113 MHz to make the odd digits.

3. If no output is obtained on any digit, if random digits are missing, or if an unsteady counter reading (noise) is present, part of the circuitry that is used on all digits must be faulty. The active devices are Q8, Q9, Q10 and Q11. DC operating conditions on all of these transistors are such that 1.1 to 1.5V should be measured across their emitter resistors R40, R45, R69 and R48. Bases of switch transistors Q3 to Q7 are at +5.2V when inactive and at +3.3V when turned on.

RF voltages at various stages are given to permit further localization of the trouble. Voltages may differ from nominal by ±3 dB.

Base Q8	0.20V
Base Q9	0.05V
Tap, L5	0.30V
Base Q11	0.10V

The 126-128 MHz signal at the tap of L5 peaks at digit setting "5" and drops approximately 2 dB for settings "0" and "9" on the preceding DM module (less significant digit).

DMA-1005 PARTS LIST

Schem. Desig.	Description	PTS P/N
	CAPACITORS	
C1	1 nF, 10%, 500V, X5F	22-0102
C2	220 pF, 10%, 500V, X5F	22-0221
C3	10 nF, 80/20%, 50V, Z5V	23-0103
C4	1 nF, 10%, 500V, X5F	22-0102
C5	1 nF, 10%, 500V, X5F	22-0102
C6	10 nF, 80/20%, 50V, Z5V	23-0103
C7	10 nF, 80/20%, 50V, Z5V	23-0103
C8	220 pF, 10%, 500V, X5F	22-0221
C9	1 nF, 10%, 500V, X5F	22-0102
C10	1 nF, 10%, 500V, X5F	22-0102
C11	1 nF, 10%, 500V, X5F	22-0102
C12	1 nF, 10%, 500V, X5F	22-0102
C13	1 nF, 10%, 500V, X5F	22-0102
C14	1 nF, 10%, 500V, X5F	22-0102
C15	1 nF, 10%, 500V, X5F	22-0102
C16	1 nF, 10%, 500V, X5F	22-0102
C17	47 pF, 5%, 500V, NPO	20-0470
C18	47 pF, 5%, 500V, NPO	20-0470
C19	47 pF, 5%, 500V, NPO	20-0470
C20	47 pF, 5%, 500V, NPO	20-0470
C21	47 pF, 5%, 500V, NPO	20-0470
C23	10 nF, 80/20%, 50V, Z5V	23-0103
C24	1.5 nF, 10%, 500V, X5F	22-0152
C26	27 pF, 5%, 500V, NPO	20-0270
C27	1-10 pF, Trimmer	26-5100
C28	5 pF, .25 pF, 500V, NPO	20-1500
C29	10 nF, 80/20%, 50V, Z5V	23-0103
C30	10 nF, 80/20%, 50V, Z5V	23-0103
C31	47 pF, 5%, 500V, NPO	20-0470
C32	22 pF, 5%, 500V, NPO	20-0220
C33	1-10 pF, Trimmer	26-5100
C34	0.68 pF, .25 pF, 500V	24-2680
C35	22 pF, 5%, 500V, NPO	20-0220
C36	1-10 pF, Trimmer	26-5100
C37	5 pF, .25 pF, 500V, NPO	20-1500
C38	15 pF, 5%, 500V, NPO	20-0150
C39	10 nF, 80/20%, 50V, Z5V	23-0103
C40	1 nF, 10%, 500V, X5F	22-0102
C41	22 pF, 5%, 500V, NPO	20-0220
C42	1-10 pF, Trimmer	26-5100
C43	0.68 pF, .25 pF, 500V	24-2680
C44	1-10 pF, Trimmer	26-5100
C45	22 pF, 5%, 500V, NPO	20-0220
C46	12 pF, 5%, 500V, NPO	20-0120

DMA-1005 PARTS LIST (continued)

Schem. Desig.	Description	PTS P/N
	CAPACITORS (continued)	
C47	1-10 pF, Trimmer	26-5100
C48	2.2 pF, .25 pF, 500V, NPO	20-1220
C49	10 pF, 5%, 500V, NPO	20-0100
C50	1-10 pF, Trimmer	26-5100
C51	6.8 pF, .25 pF, 500V, NPO	20-1680
C52	10 nF, 80/20%, 50V, Z5V	23-0103
C53	10 nF, 80/20%, 50V, Z5V	23-0103
C54	15 pF, 5%, 500V, NPO	20-0150
C55	1-10 pF, Trimmer	26-5100
C56	1.5 pF, .25 pF, 500V, NPO	24-1150
C57	12 pF, 5%, 500V, NPO	20-0120
C58	1-10 pF, Trimmer	26-5100
C59	1.5 pF, .25 pF, 500V, NPO	24-1150
C60	47 pF, 5%, 500V, NPO	20-0470
C61	47 pF, 5%, 500V, NPO	20-0470
C62	1-10 pF, Trimmer	26-5100
C63	15 pF, 5%, 500V, NPO	20-0150
C65	2.2 pF, .25 pF, NPO	20-1220
C66	91 pF, 5%, 500V, N750	21-0910
C67	15 pF, 5%, 500V, NPO	20-0150
C68	56 pF, 5%, 500V, NPO	20-0560
C69	5 pF, .25 pF, 500V, NPO	20-1500
C70	33 pF, 5%, 500V, NPO	20-0330
C71	3-13 pF, Trimmer	26-5101
C72	3-13 pF, Trimmer	26-5101
C73	3-13 pF, Trimmer	26-5101
C74	3-13 pF, Trimmer	26-5101
C75	3-13 pF, Trimmer	26-5101
C76	27 pF, 5%, 500V, NPO	20-0270
C77	150 pF, 10%, 500V, X5F	22-0150
	INDUCTORS	
L1	50 nH, nom.	35-5100
L2	50 nH, nom.	35-5100
L3	50 nH, nom.	35-5100
L4	50 nH, nom.	35-5100
L5	50 nH, nom.	35-5100
L6	50 nH, nom.	35-5100
L7	50 nH, nom.	35-5100
L8	50 nH, nom.	35-5100
L9	50 nH, nom.	35-5100
L10	50 nH, nom.	35-5100
L11	1.0 μH, 5%	36-5105

DMA-1005 PARTS LIST (continued)

Schem. Desig.	Description	PTS P/N
	RESISTORS	
R1	10 KΩ, 5%, ¼W	10-0103
R2	2.2 KΩ, 5%, ¼W	10-0222
R3	15 Ω, 5%, ¼W	10-0150
R4	680 Ω, 5%, ¼W	10-0681
R5	47 Ω, 5%, ¼W	10-0470
R6	1 KΩ, 5%, ¼W	10-0102
R7	10 KΩ, 5%, ¼W	10-0103
R8	15 Ω, 5%, ¼W	10-0150
R9	680 Ω, 5%, ¼W	10-0681
R10	2.2 KΩ, 5%, ¼W	10-0222
R11	1 KΩ, 5%, ¼W	10-0102
R12	47 Ω, 5%, ¼W	10-0470
R13	47 Ω, 5%, ¼W	10-0470
R14	680 Ω, 5%, ¼W	10-0681
R15	10 KΩ, 5%, ¼W	10-0103
R16	2.2 KΩ, 5%, ¼W	10-0222
R17	1.5 KΩ, 5%, ¼W	10-0152
R18	1.5 KΩ, 5%, ¼W	10-0152
R19	1.5 KΩ, 5%, ¼W	10-0152
R20	1.5 KΩ, 5%, ¼W	10-0152
R21	1.5 KΩ, 5%, ¼W	10-0152
R22	1 KΩ, 5%, ¼W	10-0102
R23	1 KΩ, 5%, ¼W	10-0102
R24	2.2 KΩ, 5%, ¼W	10-0222
R25	1 KΩ, 5%, ¼W	10-0102
R26	1.5 KΩ, 5%, ¼W	10-0152
R27	470 Ω, 5%, ¼W	10-0471
R28	470 Ω, 5%, ¼W	10-0471
R29	470 Ω, 5%, ¼W	10-0471
R30	470 Ω, 5%, ¼W	10-0471
R31	330 Ω, 5%, ¼W	10-0331
R32	220 Ω, 5%, ¼W	10-0221
R33	6.8 KΩ, 5%, ¼W	10-0682
R34	220 Ω, 5%, ¼W	10-0221
R35	1.5 KΩ, 5%, ¼W	10-0152
R36	15 Ω, 5%, ¼W	10-0150
R37	680 Ω, 5%, ¼W	10-0681
R38	1.5 KΩ, 5%, ¼W	10-0152
R39	6.8 KΩ, 5%, ¼W	10-0682
R40	470 Ω, 5%, ¼W	10-0471
R42	6.8 KΩ, 5%, ¼W	10-0682
R43	1.5 KΩ, 5%, ¼W	10-0152

NOTE: 10-xxxx Carbon Composition

DMA-1005 PARTS LIST (continued)

Schem. Desig.	Description	PTS P/N
	RESISTORS (continued)	
R44	15 Ω, 5%, ¼W	10-0150
R45	150 Ω, 5%, ¼W	10-0151
R46	6.8 KΩ, 5%, ¼W	10-0682
R47	1.5 KΩ, 5%, ¼W	10-0152
R48	150 Ω, 5%, ¼W	10-0151
R49	4.7 Ω, 5%, ¼W	10-1470
R50	68 Ω, 5%, ¼W	10-0680
R55	15 Ω, 5%, ¼W	10-0150
R56	15 Ω, 5%, ¼W	10-0150
R57	15 Ω, 5%, ¼W	10-0150
R58	2.2 KΩ, 5%, ¼W	10-0222
R59	150 Ω, 5%, ¼W	10-0151
R60	150 Ω, 5%, ¼W	10-0151
R62	1.5 KΩ, 5%, ¼W	10-0152
R63	15 Ω, 5%, ¼W	10-0150
R64	22 KΩ, 5%, ¼W	10-0223
R65	22 KΩ, 5%, ¼W	10-0223
R66	22 KΩ, 5%, ¼W	10-0223
R67	22 KΩ, 5%, ¼W	10-0223
R68	22 KΩ, 5%, ¼W	10-0223
	TRANSISTORS	
Q1	2SA 711	41-0711
Q2	2SA 711	41-0711
Q3	2N 3250	41-3250
Q4	2N 3250	41-3250
Q5	2N 3250	41-3250
Q6	2N 3250	41-3250
Q7	2N 3250	41-3250
Q8	2N 5179	40-5179
Q9	2N 5179	40-5179
Q10	2N 5179	40-5179
Q11	2N 5179	40-5179

DMA-1005 PARTS LIST (continued)

Schem. Desig.	Description	PTS P/N
	DIODES	
CR2	BA 244	71-0244
CR3	BA 244	71-0244
CR5	IN 4151	70-4151
CR6	IN 4151	70-4151
CR7	BA 244	71-0244
CR8	BA 244	71-0244
CR9	BA 244	71-0244
CR10	BA 244	71-0244
CR11	BA 244	71-0244
	INTEGRATED CIRCUITS	
U1	74L20N	61-5101
U2	74L00N	61-5100
M1	MD108	65-5102

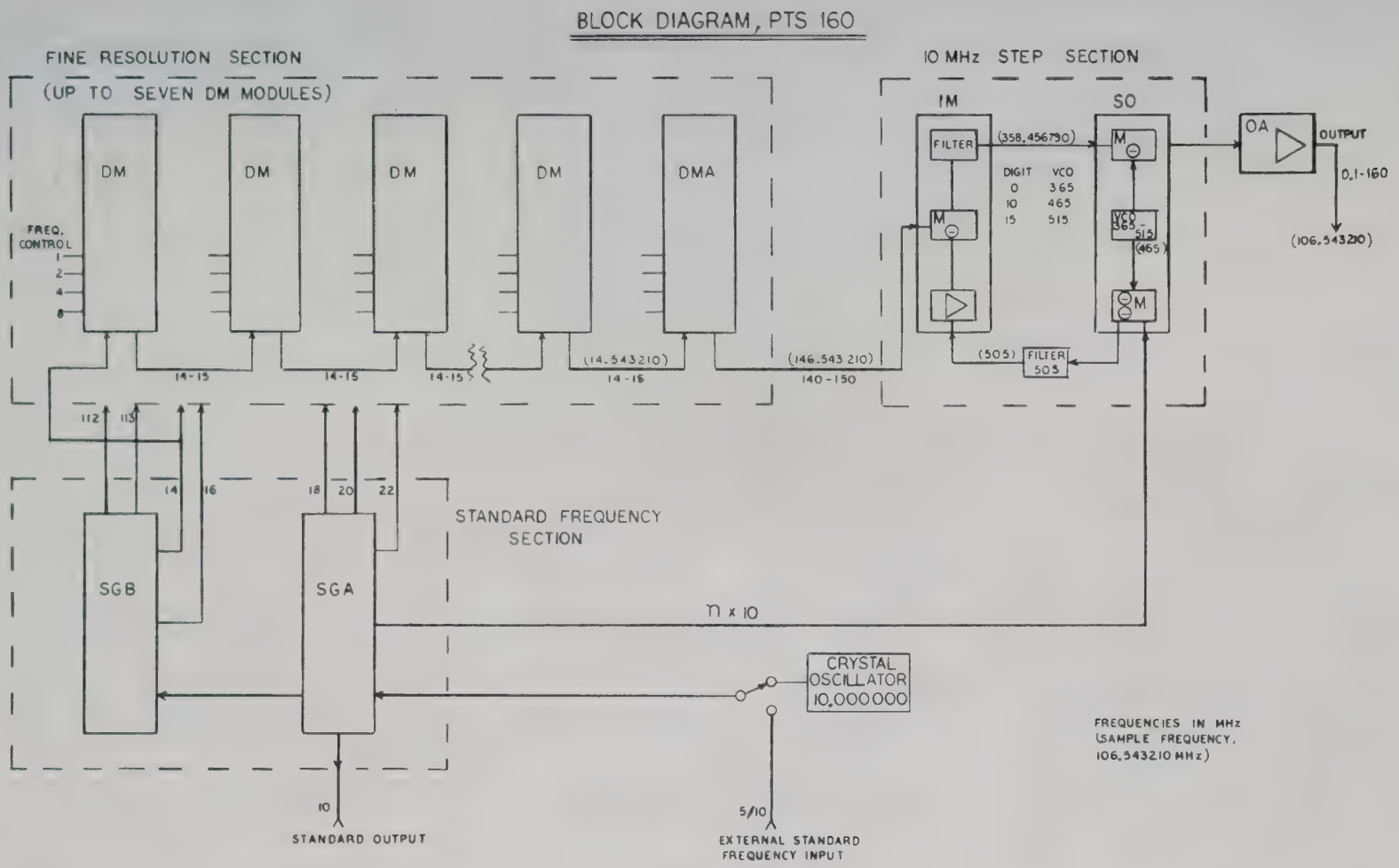
BLOCK DIAGRAM, PTS 160
FINE RESOLUTION SECTION
(UP TO SEVEN DM MODULES)
10 MHz STEP SECTION
1M
SO
DM
DM
DM
DM
DMA
FREQ. CONTROL
1
2
4
8
FILTER
(358.456790)
DIGIT VCO
0 365
10 465
15 515
VCO 365 - 515
(465)
OA
OUTPUT
0.1-160
(106.543210)
(14.543210)
14-15
14-15
14-15
14-16
(146.543 210)
140-150
(505)
FILTER 505
112
113
14
16
18
20
22
STANDARD FREQUENCY SECTION
SGB
SGA
n x 10
CRYSTAL OSCILLATOR 10.000000
FREQUENCIES IN MHz (SAMPLE FREQUENCY, 106.543210 MHz)
10
STANDARD OUTPUT
5/10
EXTERNAL STANDARD FREQUENCY INPUT

Figure 1

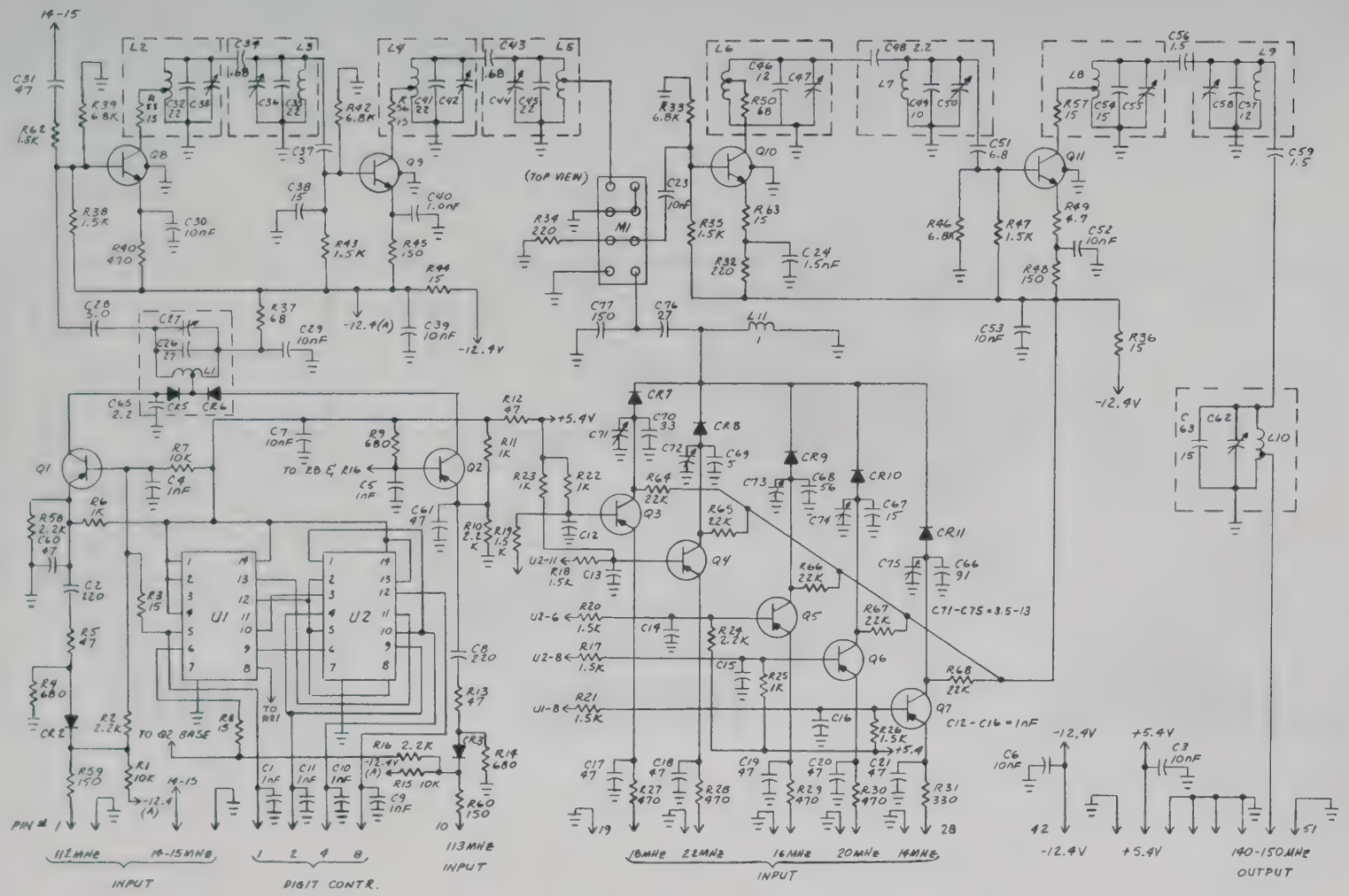
14-15
L2
L3
L4
L5
L6
L7
L8
L9
L10
L11
C31 47
R62 1.5K
R39 6.8K
R42 6.8K
C37 3
C38 15
C40 1.0nF
R43 1.5K
R45 150
R44 15
R40 470
C30 10nF
R38 1.5K
C28 3.0
C26 27
C27
R37 68
C29 10nF
-12.4(A)
C39 10nF
-12.4V
Q8
Q9
(TOP VIEW)
M1
R34 220
C23 10nF
R33 6.8K
R35 1.5K
R32 220
C24 1.5nF
Q10
Q11
R50 68
R63 15
C51 6.8
R46 6.8K
R47 1.5K
R49 4.7
C52 10nF
R48 150
C53 10nF
R36 15
-12.4V
C77 150
C76 27
C65 2.2
CR5
CR6
CR7
CR8
CR9
CR10
CR11
R12 47
+5.4V
C7 10nF
R9 680
TO R8 & R16
C5 10nF
R11 1K
C61 47
R10 2.2K
R19 15K
Q1
Q2
Q3
Q4
Q5
Q6
Q7
R7 10K
C4 10nF
R6 1K
R50 2.2K
C60 47
C2 220
R3 15
R5 47
R4 680
CR2
R2 2.2K
TO Q2 BASE
R1 10K
-12.4 (A)
M-15
R8 15
TO R21
U1
U2
R16 2.2K
-12.4V (A)
R15 10K
CR3
R14 680
R60 150
R59 150
PIN # 1
C1 1nF
C11 1nF
C10 1nF
C9 10nF
10
C8 220
R13 47
C70 33
C71
C72
C69 5
R64 22K
R65 22K
R66 22K
R67 22K
R68 22K
C73
C68 56
C74
C67 15
C75
C66 91
C71-C75 = 3.5-13
R23 1K
R22 1K
C12
U2-11
R18 1.5K
C13
U2-6
R20 1.5K
C19
R24 2.2K
U2-8
R17 1.5K
C15
R25 1K
U1-8
R21 1.5K
C16
R26 1.5K
+5.4
C12 - C16 = 1nF
C17 47
C18 47
C19 47
C20 47
C21 47
R27 470
R28 470
R29 470
R30 470
R31 330
19
28
C6 10nF
C3 10nF
42
51
-12.4V
+5.4V
112MHz
14-15MHz
INPUT
1 2 4 8
DIGIT CONTR.
113MHz
INPUT
18MHz 22MHz 16MHz 20MHz 14MHz
INPUT
-12.4V
+5.4V
140-150MHz
OUTPUT

Figure 2

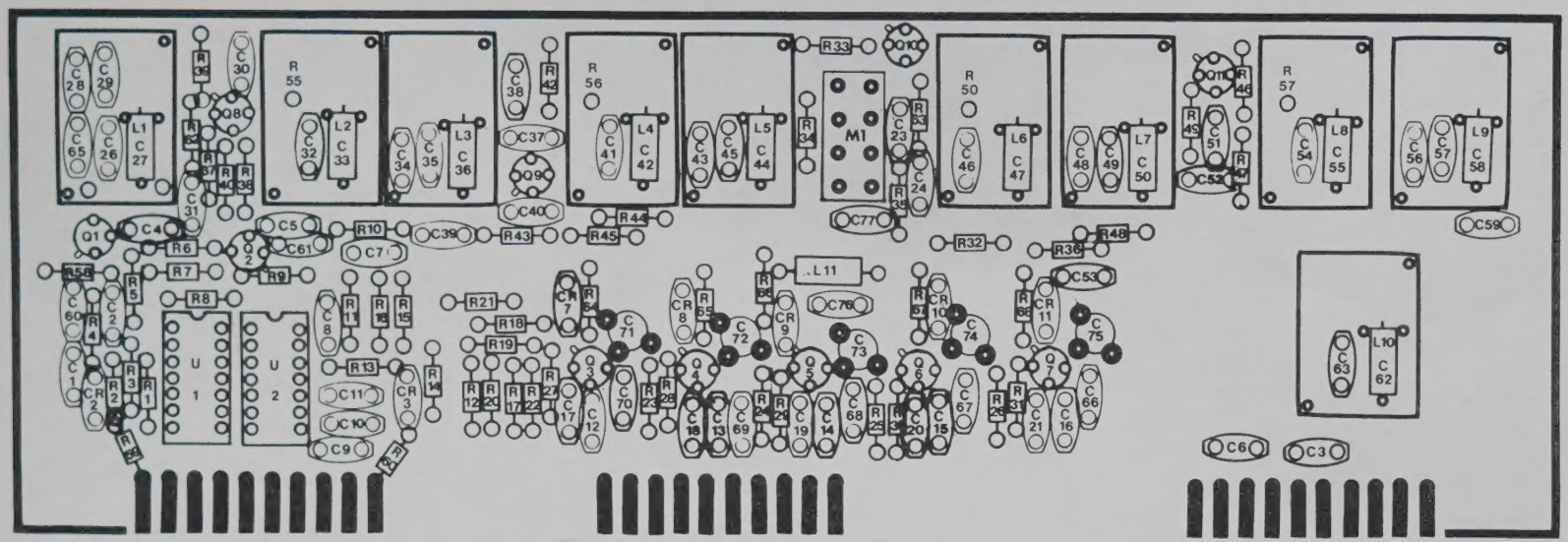
C28
C29
C65
C26
L1
C27
R55
L2
C32
C33
C34
C35
L3
C36
C38
C37
R56
L4
C41
C42
C43
C45
L5
C44
R33
M1
C23
C24
R50
L6
C46
C47
C48
C49
L7
C50
C51
C52
R57
L8
C54
C55
C56
C57
L9
C58
C59
C30
C31
C40
C39
C77
C61
C7
C5
C4
R10
R43
R44
R45
R32
R48
R36
C53
L11
C76
C60
C1
C2
R4
R3
R1
CR2
R5
R6
R7
R8
R9
U1
U2
C8
R11
R15
R13
C11
C10
C9
R14
R21
R18
R19
CR7
R54
C71
C70
C12
C17
R23
R25
CR8
R55
C72
C18
C13
C69
CR9
R24
R26
C73
C68
C14
C19
R27
R28
C20
C15
C67
CR10
R37
C74
R29
R31
C21
C16
C66
CR11
R30
C75
C63
L10
C62
C6
C3

Figure 3